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Applications of the proton induced x-ray emission (PIXE) technique for elemental analysis of materials
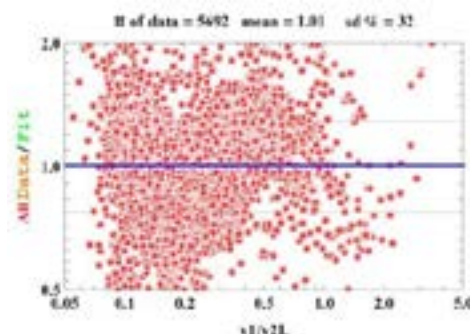
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Background: The relevance of x-ray production cross sections (XRPCS) and the related ionization cross sections (ISC) in many research areas has been described at length and analyzed in detail. X-ray emission cross sections by ion impact are a relevant input in many areas such as particle induced x-ray emission (PIXE) strongly requires trustworthy databases for XRPCS and/or reliable predictions of inner-shell ionization theories as periodically evaluated in Monte Carlo Geant4 simulations.

Purpose: The purpose of the study is to present 1) a review of the PIXE technique and its applications, and 2) universal experimental and theoretical fits to exiting databases for K and L-shell XRPCS.

Goals: The goal is to check if the theory is accurate across the periodic table of elements and a large range of projectile energies, equally comprehensive databases are essential and a universal fit for them is desired. Those fits should be in terms of a variable by which XRPCS are scaled with a minimum of adjustable parameters. L-shell XRPCS for proton energies 26 eV ≤ E1≤1 GeV and all elements with 24 ≤ Z ≤ 95 as compiled by Miranda and Lapicki 2014 are in excellent agreement with the universal fit to these data. Only 0.7% of data/fit ratios differ from 1.0 by more than a factor of 4; merely 3.4% differ by more than a factor of 2.

Conclusions: The versatility of the PIXE technique and its application will be demonstrated. It will be shown how universal experimental and theoretical fits to XRPCS serve to set reliable prediction across projectile energies and a wide range of target elements.

Biography

Gregory Lapicki has completed his PhD from New York University and continued with Postdoctoral studies for two years in the Radiation and Solid Laboratory at NYU. He has worked at Centro Atómico, Bariloche, Argentina on the Fulbright Award. In 2013-2017, he has served on the International Advisory Committee for Particle Induced X-ray (PIXE) Conferences and presented opening invited talks at five of these conferences. In 2017, he was elected to the International Honorary Committee for PIXE. He has presented invited talks at the International Symposium on ion-atom collisions and the conference on applications of accelerators in research and industry, for which in 2017 he served as an atomic and molecular physics topic Editor. He has published almost 200 refereed papers in journals such *Physical Review A, Nuclear and Instruments and Methods in Research B, Journal of Physics B, Journal of Physics and Chemistry Data, X-Ray Spectrometry, Radiation Physics and Chemistry*, with a link to one of the most recent publications in atomic and nuclear data tables.

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